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## AMPUTATION THROUGH THE LOWER THIRD OF THE FEMUR: A MODIFIED TECHNIQUE\*

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**P**ATIENTS upon whom it is necessary to perform amputations above the knee are often poor surgical risks. The vascular disease resulting in gangrene of the lower extremity, is only one part of a generalized process which may also have caused degenerative changes in the heart, brain, and kidneys. If diabetes is present, the susceptibility to infection is increased—a danger which, in any case, is great because of the bacteria in the lymphatic drainage of the necrotic area. In these patients, therefore, the plan of the operation and the manner in which it is performed, may determine whether the amputation is a life-saving or a life-taking measure.

### SURGICAL PRINCIPLES

Certain surgical principles, which in the good-risk patient may be considered more lightly, must be strictly observed. The operation must provide for (1) the maintenance of maximum blood supply to all parts of the stump; (2) accurate hemostasis; (3) a minimum amount of devitalized tissue in the wound; (4) reduction to a minimum of the amount

of foreign material allowed to remain in the wound; (5) avoidance of muscle tissue; and (6) elimination of tension in the closure of all soft tissues.

Any present-day amputation can be but a modification of procedures that have previously been described, and any such modification has for its goal improved technique and end-results. I wish to present a procedure for amputation above the knee which, I believe, (1) simplifies the performance; (2) assures more strict observance of the surgical principles just listed; and (3) produces a most satisfactory stump.

### AUTHOR'S MODIFICATION

The operation is performed with the patient in the prone position. By this means the important vascular structures of the posterior thigh are brought into easy surgical accessibility. Sandbags are placed under the upper part of the thigh to elevate the knee three or four inches from the table. The lower one-half of the thigh and the upper one-third of the leg are surgically prepared, and the lower part of the leg and foot are wrapped in sterile dressings to avoid contamination of the wound when the knee is flexed. The entire area is then brought through the opening of a laparotomy sheet so that free motion of the knee is permitted throughout the operation.

With the knee flexed at a right angle, an incision which extends to the deep fascia is made around the leg at a level corresponding to the lower end of the tibial tubercle. The ligamentum patella is incised transversely. The joint capsule is incised on each side of the patella to a level above the upper margin of the patella into the suprapatellar bursa, and the anterior superficial structures are separated from the capsule of the knee joint. The tendon of the biceps femoris is detached from the head of the fibula, by a crosswise incision close to the bone. The tendinous attachments of the semitendinosus, semimembranosus gracilis, and sartorius muscles are detached from the medial tuberosity of the tibia. The knee is extended and the popliteal space is opened in the line of incision. The popliteal space is exposed by retraction en masse of

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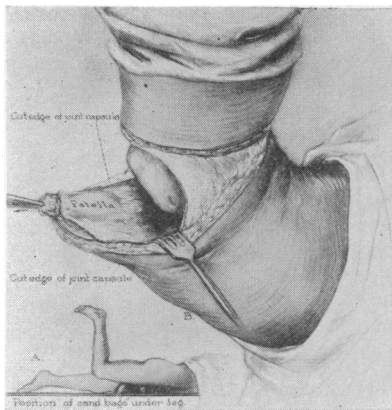


Fig. 1

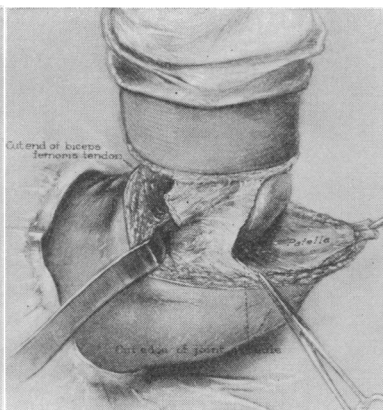


Fig. 2

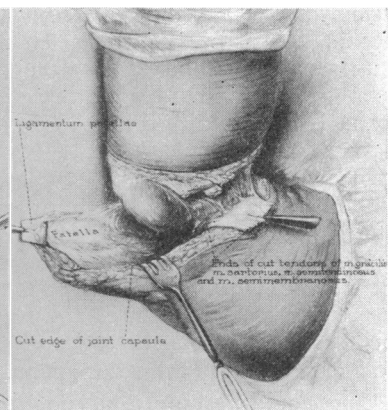


Fig. 3

Fig. 1—(a) Patient in prone position with sandbags under thigh. (b) Circular incision to the deep fascia at level of lower border of tibial tubercle. Patellar ligament detached. Incision of joint capsule over suprapatellar bursa.

Fig. 2.—Lateral view. Detachment of biceps tendon from head of fibula.

Fig. 3.—Medial view. Detachment of semitendinosus, semimembranosus, gracilis, and sartorius muscles from head of tibia.

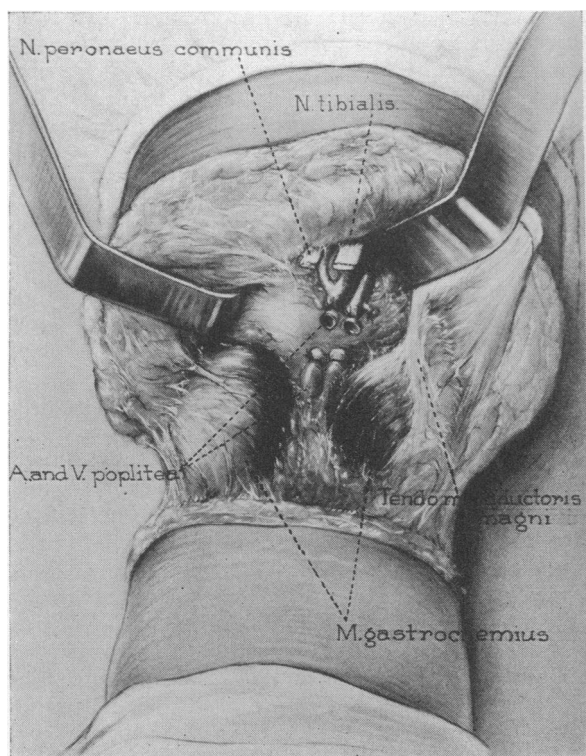


Fig. 4.—Popliteal space has been opened by incision of popliteal fascia, nerves have been divided, popliteal artery and vein have been divided and ligated.

the posterior structures which have been sectioned. The tibial and common peroneal nerves are located and sectioned as high as possible, and the popliteal artery and vein, or veins, are located and ligated separately, or together, and sectioned. The remaining fat of the popliteal space is cleared from the bone and patent arteries which form the anastomosis around the knee are ligated. The adductor longus tendon and the adductor fascia are detached from the tubercle, and the site for the section of the bone above the origin of the posterior crural muscles is selected. All soft tissues are retracted, the bone is sectioned, and the anterior margin of the bone is beveled. The patella is then removed from the capsule.

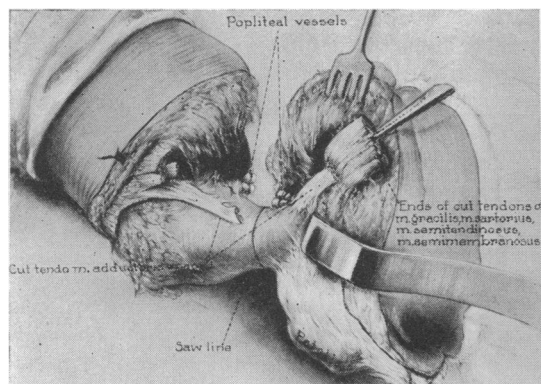


Fig. 5

Fig. 5.—Medial view. Detachment of adductor longus. Site of section of bone above the origin of the crural muscles and below the origin of the quadriceps tendon.

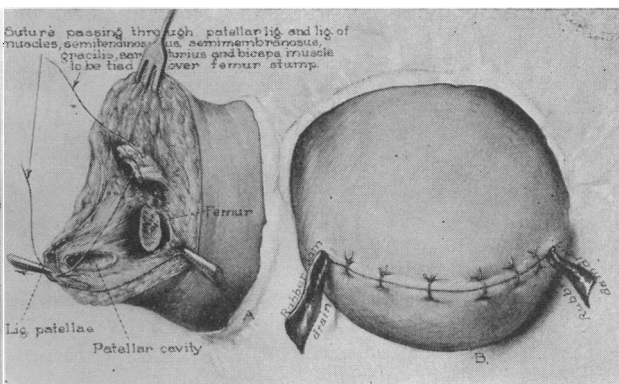


Fig. 6

Fig. 6.—(a) Patella has been removed. Single silk suture through all of the tendons except the adductor longus, ready to draw tendons over the end of the bone. Retraction of the posterior muscles covers the bone with the quadriceps tendon, and displaces the line of closure posterior to the femur. (b) Closure of stump. Drains optional.

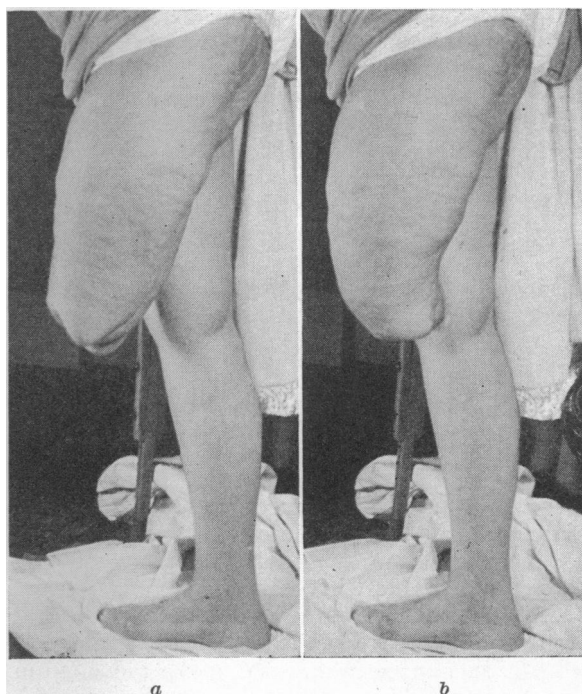


Fig. 7.—End result. (a) Stump with quadriceps tendon contracted. (b) Stump with flexor tendons contracted. Voluntary movement of soft tissues over bone.

In closing, a single silk suture is passed through the tendon of each detached muscle, except the adductor longus, and tied over the end of the femur. The skin and superficial fat are closed transversely with loosely tied sutures, and a small drain, which is allowed to remain in place for twenty-four to forty-eight hours, is placed in each angle of the wound.

#### COMMENT

There are six outstanding advantages to the procedure which I have described:

1. The approach from the posterior aspect of the thigh permits full vision and easy surgical accessibility to the important structures throughout the operation, since the main and collateral blood vessels and the nerves at this level lie posterior to the femur. The tendon of the quadriceps femoris,

with its ligamentous expansion, is essentially the only important structure, from a surgical point of view, on the anterior aspect of the thigh. By this approach it is possible to secure accurate hemostasis of individual vessels with small ligatures, and to avoid mass ligations.

2. The circular incision assures a maximum blood supply to the superficial structures of the stump. The fact that flaps are not fashioned, obviates the necessity for lateral and medial longitudinal incision. Dissection within the remaining soft tissue is avoided, and retraction of these structures en masse, after sectioning, further assures uninterrupted blood supply.

3. The use of a single silk suture to draw the tendons of the detached muscles together over the bone results in an obliteration of dead space. As soon as the effects of the anesthesia have passed, muscular contraction retracts and stabilizes these structures snugly over the end of the bone. The use of only one suture also reduces the amount of foreign material left in the wound.

5. The avoidance of muscle tissue. This has been especially reemphasized recently by Callander, who has convincingly demonstrated a reduction in postoperative infection and mortality by minimizing trauma to muscle.

6. The end-result is an amputation stump in which the end of the bone is covered not only by skin and subcutaneous fat, but by tendons and deep fascia as well. The anatomical pattern of the remaining thigh is retained, and all soft structures to the end of the stump are movable by voluntary muscular action.

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## DISSECTING ANEURYSM\*

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ALTHOUGH less than four hundred case reports have been published, dissecting aneurysm is not very rare. Like coronary thrombosis a few years ago, it is now only beginning to be recognized clinically; but the antemortem diagnosis will undoubtedly become common with better understanding of the morbid anatomy and physiology of the condition and the corresponding clinical phenomena.

### PATHOLOGY

Dissecting aneurysm is a separation of the coats of an artery by escaped blood. Of the reported cases all but a few were in the aorta, with or without extension to its branches. Three were in the pulmonary artery,<sup>10</sup> and others have been mentioned in cerebral or other smaller arteries. The blood may come exclusively from vasa vasorum;<sup>11</sup> usually the intima is broken secondarily, if not initially. The cleavage plane is in the outer part of the media. If the adventitia is also quickly penetrated at a near-by point, the episode is spoken of simply as "*rupture of the aorta*": but more or less dissection is the rule in *spontaneous rupture*—not,

however, in traumatic rupture. Most dissecting aneurysms soon rupture externally—into the pericardium (more than 50 per cent), left pleural cavity, mediastinum, retroperitoneal tissue, or elsewhere. "Spontaneous" rupture of the undiseased aorta has often been mentioned, with the suggestion that it occurs at "points of lowered resistance," *e. g.*, at the site of a congenital stenosis or at the insertion of the atrophied ductus arteriosus. Two or three centimeters above the aortic valve is the common location. But in the absence of severe trauma, which is rarely alone responsible, it is probable that serial sections would show antecedent disease in most or all cases.

Syphilis is not the cause, and its sclerosing effect on the media may even prevent dissection—witness the patient of Weiss,<sup>12</sup> in whom dissection bordered but failed to invade a syphilitic area. Possibly other infections or obscure atheromatous lesions are at times responsible. But undoubtedly the usual cause is Erdheim's<sup>2</sup> *medionecrosis aortae idiopathica cystica*. These cysts, possibly of toxic or infectious origin, often multiple, of various sizes but often invisible to the naked eye, are filled with collagenous or necrotic material, and in their formation involve the destruction of medial tissue. They are found at times in the absence of dissecting aneurysm.<sup>9</sup> The tears of the intima which they cause are occasionally multiple,<sup>8</sup> and often appear as slits at a right angle to the direction of blood flow, *i. e.*, favorable to dissection. The aneurysm usually does not embrace the entire circumference of the aorta.

Dissection may progress gradually or intermittently, at times with arrest, thrombosis, organization, and repair; or it may rush through the entire course of the aorta and into one or more large branches. Branches may be choked, or small ones torn off in the process. External ballooning may compress neighboring structures, a remarkable example being that of George II of England, whose dissecting aneurysm compressed the pulmonary artery with resultant rupture of the right ventricle—the catastrophe while straining at stool.<sup>6</sup> And the separated inner coats bulge into the lumen of the vessel and may more or less completely block it, reducing circulation below and raising pressure above. Occasionally this diversion of pressure forces the aneurysmal blood back into normal channels by rerupture into the lower aorta or into one or more of its branches. A few have survived after such an escape-valve effect, the new channel in time becoming endothelialized and carrying part or most of the stream.

### DIAGNOSIS

The clinical picture of dissecting aneurysm, with its pain, anxiety, collapse and generally shock-like appearance, has been so commonly confused with that of coronary thrombosis that, in the following description, comparative remarks on the latter condition are included parenthetically. Most of the patients with dissecting aneurysm are middle-aged men, but many are under thirty-five. (Coronary: rare under thirty-five.) Three or four per cent of the reported cases were in advanced pregnancy.<sup>3,4</sup>

\*Read before the Section on General Medicine of the California Medical Association at the sixty-ninth annual session, Coronado, May 6-9, 1940.